99B-119

Proposal Title:
Ecosystem Development at the Cosumnes River Preserve: Model Restoration Experiments for the Central Valley and Beyond

Applicant Name:
San Jose State University Foundation

Mailing Address:
P. O. Box 720130, San Jose, CA 95172-0130

Telephone: (408) 924-2488

Fax: (408) 924-2477

Email: nibrahim@email.sjsu.edu

Amount of funding requested: $492,597 for 3 years

Indicate the Topic for which you are applying (check only one box).

- ☐ Fish Passage/Fish Screen
- ☒ Habitat Restoration
- ☐ Local Watershed Stewardship
- ☐ Water Quality
- ☐ Introduced Species
- ☐ Fish Management/Hatchery
- ☐ Environmental Education

Does the proposal address a specified Focused Action? X yes ____ no

What county or counties is the project located in?

Indicate the geographic area of your proposal (check only one box):

- ☐ Sacramento River Mainstem
- ☐ Sacramento Trib:
- ☐ San Joaquin River Mainstem
- ☐ San Joaquin Trib:
- ☐ Delta:
- ☒ East Side Trib:
- ☐ Suisun Marsh and Bay
- ☐ North Bay/South Bay:
- ☐ Landscape (entire Bay-Delta watershed)
- ☐ Other:

Indicate the primary species which the proposal addresses (check all that apply):

- ☐ San Joaquin and East-side Delta tributaries fall-run chinook salmon
- ☐ Spring-run chinook salmon
- ☒ Fall-run chinook salmon
- ☐ Longfin smelt
- ☐ Steelhead trout
- ☐ Striped bass
- ☐ All chinook species
- ☐ All anadromous salmonids
- ☐ Winter-run chinook salmon
- ☐ Late-fall run chinook salmon
- ☒ Delta smelt
- ☒ Splittail
- ☐ Green sturgeon
- ☒ Migratory birds
- ☐ Other:

Specify the ERP strategic objective and target (s) that the project addresses. Include page numbers from January 1999 version of ERP Volume I and II:
Central Valley stream flows and riparian & riverine aquatic habitats ERP vol. I, p. 16. Implementation objective for season wetlands and perennial aquatic habitat vol. I, p. 74. Ecological objectives for wetland and riparian habitats vol. II, p. 258. Ties with programmatic objectives for Cosumnes ecological unit vol. II, p. 346 & 360.

Indicate the type of applicant (check only one box):

- ☐ State agency
- ☐ Public/Non-profit joint venture
- ☐ Local government/district
- ☐ University
- ☐ Federal agency
- ☐ Non-profit
- ☐ Private party
- ☒ Other: Non-profit Auxiliary to SJSU

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I-014193

Indicate the type of project (check only one box):

☐	Planning	☐	Implementation
☒	Monitoring	☐	Education
☐	Research		

By signing below, the applicant declares the following:

1.) The truthfulness of all representations in their proposal;
2.) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and
3.) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Nabil Ibrahim, Acting AVP, Graduate Studies and Research
Printed name of applicant

N. Ibrahim
Signature of applicant

I-014194

Title: Ecosystem Development at the Cosumnes River Preserve: Model Restoration Experiments for the Central Valley and Beyond

Contact Name:	**John S. Oliver**
Title:	**Adjunct Professor**
Address:	**Moss Landing Marine Laboratories** **Benthic Lab** **P. O. Box 450** **Moss Landing, CA 95039**
Phone:	**831-633-7250**
Fax:	**831-633-5642**
Email:	oliver@mlml.calstate.edu

Participants and Collaborators:

Moss Landing Marine Laboratories, San Jose State University
The Nature Conservancy
CDF&G Water Pollution Control Laboratory
CDF&G Marine Pollution Study Group
University of California at Davis, Department of Environmental Science and Policy
Watershed Institute, California State University, Monterey Bay

Type of Organization: **Non-profit auxiliary organization to San Jose State University, 501(c)(3)**

Federal Tax ID Number (San Jose State University Foundation): 94-601-7638

I-014195

I. Executive Summary

Ditching, diking, draining and diverting water from rivers, creeks and marshes has severely degraded water resources throughout the world (National Research Council 1992). Naturally wet landscapes have been dried and their ecosystems lost or endangered. This freshwater crisis is the most critical environmental problem in the state, the Central Valley, and the bay/delta system. The most important positive action is to restore, as much as possible, the core of the natural water system, the wet corridors, where the retention and flow of water is greatest, in the rivers, creeks and marshes (National Research Council 1992, Mitsch and Gosselink 1993, Karr and Chu 1999). The Nature Conservancy's Cosumnes River Project is the best example of river restoration in an agricultural landscape within the state. Wherever possible, the example should be emulated along every wet corridor in the CALFED project area. No other management strategy is more important.

The Cosumnes River Preserve illustrates the three most important landuse practices or experiments that can be implemented along the wet corridors of the valley: 1) restoring natural river meander, 2) vegetating all waterways with appropriate native plant communities, and 3) conducting minimum ecological impact farming on lands adjacent to rivers. These landuse strategies, or experiments, maximize the recovery of all ecosystem services from the wet landscape, including greatly improved surface water retention, flood protection, water quality, ground water recharge, biodiversity and habitats for fish and other aquatic organisms. The strategies are consistent with the CALFED ERP objectives, focusing on priority habitats and species, and are fundamental to the success of the Strategic Plan for Ecosystem Restoration. Restoration of wet corridor ecosystems is essential to a sustainable future in all watersheds.

The three landuse experiments on the Preserve should be monitored to educate the broadest spectrum of the public about the need for ecosystem restoration, its successes, and the costs and benefits. The experiments have been in progress for a number of years. This proposal concerns the first monitoring of improvements to water quality and benthic invertebrate communities, which are the best indicators of ecosystem development and general health (Karr and Chu 1999) as a result of these experiments. Plankton communities will be sampled in floodplain habitats to provide a more complete ecosystem perspective. The proposed monitoring will be compared to ongoing sampling of fishes, birds, and the succession of riparian plant communities on the Preserve, with all studies integrated to evaluate habitat quality for fishes and the entire aquatic ecosystem.

The most important landuse strategy implemented on the Preserve is to open dikes allowing the Cosumnes River to flow and flood more naturally, and where necessary to construct secondary berms defining a much wider natural wet corridor. Fortunately, this is possible along extensive river reaches in agricultural landscapes, but still only involves the conversion of a small fraction of farmland to wet ecosystem. The recovery of the river ecosystem on the adjacent low floodplain (over 500 acres) greatly improves flood protection, as illustrated on the Preserve in the 1996 floods; and provides large habitat areas for the early life stages of threatened native fish species, including Chinook salmon, splittail and delta smelt. The developing plant communities create a wetland filter improving water quality and habitat for fish prey communities — the focus of our sampling.

The second landuse strategy implemented on the Preserve is to vegetate drainage ways with native plant communities. Well developed plant communities along the old ditch systems (about 50 acres of sloughs) greatly improve water quality, fish habitats, and aquatic ecosystems. The adjacent agricultural landscape is cut with extensive ditch drainage systems that are mostly unvegetated. The ditches have poor habitat and water quality. Almost all uncultivated farmland is kept free of vegetation or is periodically covered with invasive non-native plants; this includes the drainage ditches.

The third landuse strategy involves a wide variety of practices that can minimize adverse impacts to adjacent wet ecosystems. On the Preserve, this proposal focuses on organic rice farming which has been developed adjacent to the sloughs and restored river areas. Properly managed, these fields significantly improve water quality and provide wetland ecosystems that are used by invertebrates, waterfowl and other birds. Another important landuse practice on the Preserve has been to vegetate all uncultivated bare ground with appropriate native plant communities, such as the edges of fields, roads, staging areas, and impervious surfaces. Although these upland habitats are

not the focus of the present proposal, they undoubtedly have indirect positive impacts on aquatic ecosystems and will be considered in the sampling design.

The Cosumnes River Project implements the most important examples of ecosystem restoration in the CALFED project area, providing an unprecedented opportunity to document improvements to water quality and concomitant recovery of freshwater habitats and ecosystems. The study has particular utility in assessing the increase in habitat value for fishes. We will monitor the three primary landuse experiments by sampling: 1) a series of water quality parameters, 2) benthic invertebrate communities (ecosystem health indicators), 3) physical and chemical properties of the sedimentary habitats (as part of a broader habitat characterization), and 4) midwater plankton within the floodplain. Combined with ongoing sampling of fishes, birds and plant communities, these new data will illustrate the success of the Preserve Project. They are essential for educating a broad spectrum of the public, for developing economic and ecological costs and benefits, and for spreading the restoration strategies throughout the Central Valley and state. Sampling of benthic invertebrate communities and plankton will also be a valuable and necessary first step toward developing standard rapid bioassessment indices for seasonally flooded habitats and sloughs.

Our group has sampled benthic invertebrate communities in coastal ecosystems around the world for many years, using a wide variety of technologies and analytical approaches. More recently we have developed partnerships to sample benthic invertebrate and algal communities in freshwater ecosystems. We also have sampled sediment and water quality in coastal watersheds and throughout the ocean. In the last 5 years, we established the Watershed Institute and implemented over 30 habitat restoration projects in the Monterey Bay area, mostly in the Salinas Valley, an agricultural landscape with a highly degraded natural water system similar to the Central Valley. We developed a partnership with the Nature Conservancy because the Cosumnes River Project is the most realistic, large-scale example of river restoration in the extensive farming landscapes of the state. We are unlikely to open dikes along the Salinas River for another decade or more. The documented success of the Cosumnes Project and the ensuing cost/benefit analysis will help implement similar projects in the Monterey Bay area, where we also cannot have a sustainable future without the restoration of the core of our natural water system (Gordon 1996, Oliver et al. 1997). At approximately $150,000 per year, the proposed 3-year study is both economical and cost effective. The project directly links and enhances the results of other studies on the Preserve as well as other bay-delta watersheds.

II. Project Description

The Nature Conservancy implemented three landuse strategies/experiments in the Cosumnes River Preserve that are outstanding examples of restoration and land management around a major river. These experiments make the Preserve the best example of ecosystem restoration in the bay/delta area, the Central Valley, and throughout the extensive agricultural landscapes of the state. While the increase in habitat value from the restorations is well recognized, the collateral positive impacts to regional water quality have not been documented or recognized. We propose to sample water quality and aquatic ecosystems to assess the success of these three restoration and landuse practices in the Preserve, particularly success at cleaning surface waters and developing aquatic habitats and ecosystems.

A. Landuse Strategies/Experiments

1. Seasonally flooded river habitat

Like most rivers and creeks in the Central Valley, the Cosumnes River was straightened, channelized, and diked. The river was expanded several times in the Preserve by opening dikes in locations where the river historically flowed. This action, combined with ecologically engineered secondary dikes, defines a more natural river area while protecting adjacent land use. Throughout the wet season, formerly cultivated lands are submerged, the river carves new channels, and aquatic habitats gradually develop. Oak woodlands are now flourishing with seasonal flooding. Cottonwoods, willows, and other riparian plants colonized large areas after each dike openings. Since dikes were opened at different times, gradients of natural ecological successions have resulted around each opening. In addition, a new opening is likely to be made

I-014197

during the proposed 3 year study, permitting us to sample the earliest stages of colonization and habitat and ecosystem development. The developing wetland as a natural filter removes garbage, suspended sediments, nutrients, and other chemical contaminants from water. Water quality and benthic and planktonic communities have not been sampled from any of these flooded river habitats.

2. Naturally vegetated ditches/sloughs

The historic farm ditches of the Preserve are naturally vegetated and referred to as sloughs. The native plant communities provide habitat structure for fishes and other aquatic animals as well as a wetland filter to improve water quality. Farm land around the Preserve support ditch systems with little or no native or even weedy vegetation. Habitat values and water quality are poor. These ditches provide a revealing contrast to the naturally vegetated sloughs in the Preserve. Water quality and aquatic communities have not been sampled in either the natural or ditched systems.

3. Wetland organic rice farming

Organic rice farming is an economically viable practice which sustains wetlands within the low floodplain adjacent to the expanded river. Modern organic rice farming offers a refuge to wildlife, particularly waterfowl, without the pesticide loading of conventional rice farming. While organic rice farming appears to have a beneficial effect on water quality, it has not been documented—nor have the general ecosystem values that are indicated by benthic invertebrate communities. Our results can be compared to ecosystem values of conventional rice farming under cultivation practices that are more and less friendly to waterfowl. On the Preserve, rice fields are constructed to drain into the adjacent natural wetlands. These persistent wetlands may provide important habitat refuges for animals that use the seasonally flooded rice fields, and may enhance the general habitat and ecosystem value of the cultivated wetlands and the Preserve lands in general.

B. Primary Research Activities

1. Water Quality

The proposed study will provide the first data to demonstrate the changes in water quality as it flows across the recovering floodplain and through the sloughs and organic rice fields on the Preserve. Water quality monitoring stations will be located where water overflows into the top of the recovering floodplain and where it enters the slough system at the bottom. Stations also will be located at vegetated slough sites within the Preserve and in non-vegetated ditches on adjacent farm lands. Other stations will be located where water enters rice fields and where it flows out. Sampling locations, times, and target measurements will be coordinated with existing water quality monitoring programs in the river above and below the Preserve. Sediment and nitrate in water will be used as a general indicators of drainage inputs, particularly from farm, dairy, and grazing land (Oliver et al. 1997). These inputs will be monitored seasonally and at peak rainfall events.

2. Habitat Quality

In addition to water quality, physical and chemical characteristics of the sedimentary environments will be sampled at each water quality station as part of a larger evaluation of habitat quality. The habitat conditions, including flow regime, will be compared/correlated to benthic invertebrate communities to help describe and assess ecosystem health, and will be used in selecting parameters to include in a multi-metric index of ecosystem health (see below). Plankton will be sampled from the flooded river areas to provide additional information on habitat quality for fishes.

3. Ecosystem Health

Benthic invertebrate communities will also be sampled at the water quality sites. We need realistic biological data to indicate the health or status of ecosystems, especially wet ecosystems. Using benthic invertebrate communities, the Environmental Protection Agency's rapid bioassessment protocol integrates the effects of water quality over time; is sensitive to multiple aspects of water and habitat quality; and is a more realistic and useful expression of ecological

health than chemical or toxicity analyses (Gibson 1996, Barbour et al. 1997, Karr and Chu 1999). Fish indices are less useful, particularly for systems west of the Rocky Mountains, especially in California (Moyle & Marchetti 1998) and specifically in the Cosumnes River. Karr and Chu (1999) describe the development and application of rapid bioassessment in running water. Benthic invertebrate communities are sampled and population and community parameters are used to generate a simple index of ecosystem health. The index is realistic and based on sound disturbance ecology. Parameters are used only if they are known to respond to gradients of environmental disturbance. For example, oligochaete worms are abundant in organic rich sediments (often highly impacted by human activities) and less abundant in sediments with lower levels of organic material (more natural conditions). In the marine environment, the most renowned indicator of organic enrichment and many other disturbances is the polychaete worm, *Capitella* spp. (Pearson and Rosenberg 1978, Grassle and Grassle 1976). A multimetric index is calculated based on parameters (called metrics) that are known to change along disturbance gradients.

In the proposed study, we will work with the CDFG Water Pollution Control Laboratory (Jim Harrington) to develop metrics for ponded, deep, or boatable aquatic habitats which include the seasonally flooded river habitats, the sloughs, and flooded rice fields on the Preserve. Recall that so far metrics are developed only for running water (Karr and Chu 1999). We will generate population and community data that can be correlated with a number of habitat variables which are related to environmental disturbance gradients. We are working in different ponded, deep, and boatable habitats in the Monterey Bay area. The work from both regions will contribute to the objective of expanding rapid bioassessment into these aquatic habitats.

C. Proposed Scope of Work

Sampling sites and project location are shown in Figures 1 and 2. Figure 3 outlines the schedule of tasks, and Table 1 shows the number of sampling stations and intervals for each task.

1. Field Work

Task 1: We will establish stations where water flows into and out of each of the three types of landuse experiments, and will sample water quality at each station during periods of representative water flow and retention. We will sample dissolved oxygen, temperature, turbidity, pH, and conductivity using a Solomat multi-channel water quality probe. Water will be collected for transport back to the lab for nutrient and other analyses.

Task 2: We will collect sediment samples at each station where benthic communities are sampled. Sediment will be analyzed in the laboratory for physical and chemical sedimentary structure as part of a more general habitat characterization. For example, we will make field observations on ripple marks and other physical sedimentary structures, dead plant and other debris, living plant cover, and hydrology.

Task 3: We will quantitatively sample plankton on the seasonally flooded river areas to further characterize habitat quality for fishes.

Task 4: We will quantitatively sample benthic invertebrate communities at water quality stations during the season when they are best developed (as determined by more frequent qualitative sampling). We also will select several representative stations to quantitatively sample more frequently to document seasonal development of benthic communities. We will use or modify standard rapid bioassessment techniques when applicable, including flow regime, as well as protocols being used and developed by our group in the Monterey Bay area in cooperation with the CDFG Water Pollution Control Laboratory.

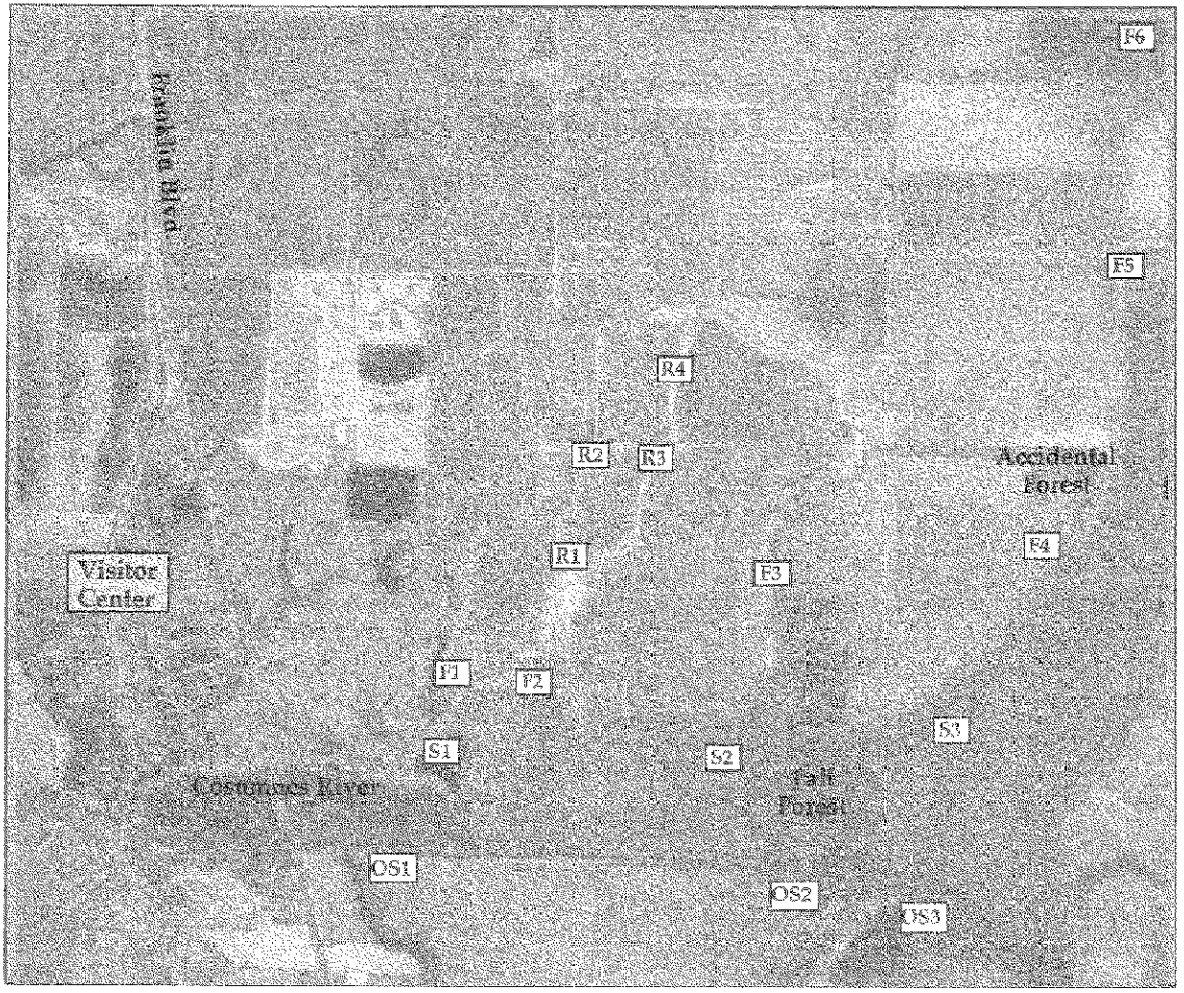
2. Laboratory Work

Task 5: We will measure nitrates and phosphates in water collected from field stations and will save some water samples for potential additional analyses in the future.

Task 6: We will measure the distribution of physical grain size and organic carbon content of sediment samples collected from the field stations. Sediment will also be examined for other habitat qualities such as dead and living plant material and biogenic structure such as tubes.

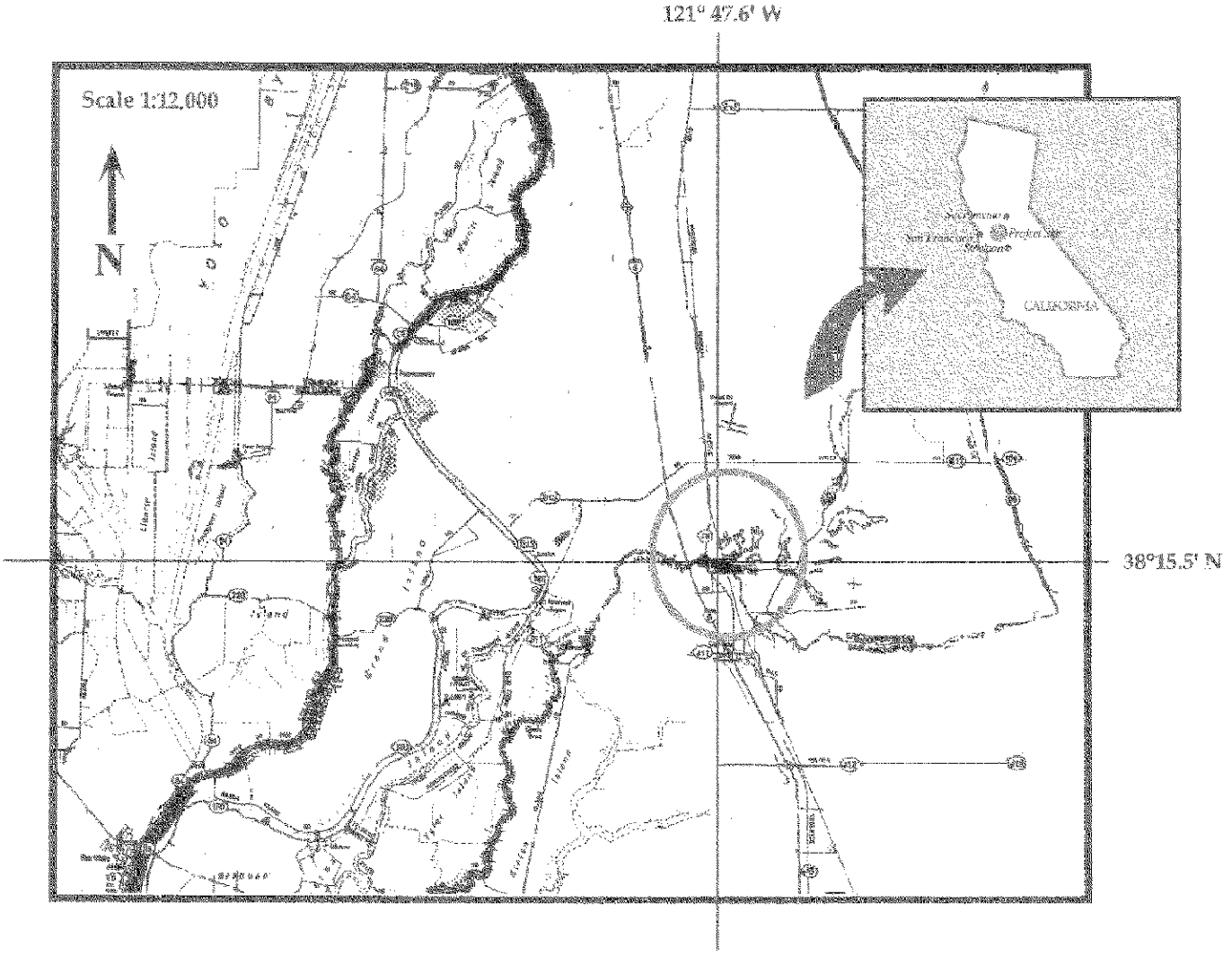
Task 7: We will sort zooplankton and count them after identification to the lowest desirable taxon.

Figure 1. Locations of sampling sites on the Cosumnes River Preserve, Sacramento County, California. F=floodplain sites; S=slough sites, OS= off-preserve slough sites; R=rice field sites. F6 is located at the Twin Cities Bridge, off map.



I-014200

Figure 2. Location of the project site on the Cosumnes River and floodplain of the Nature Conservancy's Cosumnes River Preserve near the confluence of the Sacramento and San Joaquin Rivers. Sacramento County, California.



I-014201

Table 1. Field sampling station locations and times.

HABITAT	LOCATION	TIME	No. STA	No. SAMPLE
		WATER QUALITY FIELD SAMPLING		
floodplain	dike breaches	when flooded in winter/spring	3	10
floodplain	where water enters down-stream sloughs	when flooded in winter/spring	3	10
slough	Preserve	year-round/ seasonally	3	10
slough	off-site/ adjacent	year-round/ seasonally	3	10
rice field	water inlet	when flooded May-June	2	10
rice field	water outflow	when flooded May-June	2	10
		SEDIMENT FIELD SAMPLING Grain size/organic carbon		
		samples will be collected concurrently with water quality samples above		
		BENTHIC INVERTEBRATE FIELD SAMPLING		
		samples will be collected concurrently with water quality samples above		
		PLANKTON TOWS		
floodplain	representative sub-habitats	when flooded in winter/spring	3	10

Task 8: We will sort benthic invertebrates and count them after identification to the lowest desirable taxon, either to meet standard rapid bioassessment protocols, to modify the protocols for the Preserve environments, or to gain insights into ecosystem development and health. Additional insights may be gained by recording natural history such as reproductive status, sex, size, and various behaviors.

3. Data Analyses

Task 9: We will store water quality data in Excel, and calculate all summary statistics for graphical and tabular presentations.

Task 10: We will store physical and chemical data from sediments and other habitat characterization data in Excel, and calculate summary statistics for graphical and tabular presentations.

Task 11: We will store plankton and benthic invertebrate community data in Excel, and calculate summary statistics for graphical and tabular presentations.

Task 12: We will use the water quality, sediment, and other habitat data to investigate the relationship between potential environmental disturbance gradients and benthic community patterns to select biological parameters for a multi-metric index (as described by Karr and Chu 1999). This is the first step in developing rapid bioassessment protocols for more ponded, non-running waters.

Task 13: We will compare water quality and other measures of habitat quality with benthic community patterns in graphical presentations. Searching for realistic ecological patterns in the descriptive statistics is the most important first step in examining the monitoring data (Hurlbert 1984). We will also explore statistical correlations, apply other pattern searching techniques such as cluster analyses, and make inferential statistical comparisons where appropriate.

Task 14: Results will be presented in two annual data reports and in a final report for the project at the end of the third and last year. The final report will be placed on a website that can be updated and expanded.

Task 15 : San Jose State University Foundation will administer the contract and provide the contract fiscal manager. The project director will oversee all technical aspects of the research including the field and laboratory work, data analyses, report writing, and interactions with co-investigators and other research staff. The project manager will directly supervise and implement Tasks 1-8, and work closely with the project director, co-investigators, and other research staff to complete tasks 10-12.

D. Location and/or Geographic Boundaries of the Project

All sampling will take place on and adjacent to the Cosumnes River Preserve (38°15.5', 121°47.6') Sacramento County, California (Figure 2). The Preserve is located entirely within the Cosumnes River Watershed.

III. Ecological Benefits

A. Watershed Degradation

Essentially all of the rivers and creeks in the Central Valley have been confined to narrow channels by dikes. Most have been ditched. These narrow channels have severely degraded the ecosystem services provided by a more natural water system, which normally would spread over a broad wet corridor. Surface water is channeled and moves rapidly through the landscape with the result that flood storage is dramatically reduced, water quality is low, and wet ecosystems are endangered. Ground water is often over pumped and impacted by surface waters with poor water quality. There is less positive water pressure on most ground water recharge areas. Fresh water is diverted from one watershed to another. The landscape is becoming more arid because less water is retained on the surface and for shorter periods of time, and by the accumulation of salts. Salt water from the bay intrudes further and further inland (Bay Institute 1998). Similar fresh water crises are occurring around the world, particularly in warm temperate climates (National Research Council 1992, Mitsch and Gosselink 1993, Barbour et al. 1993, Runnels 1995, Gordon 1996).

B. The Best Solution: Cosumnes River Preserve Project

The most important positive action that can be taken to solve this watershed degradation is to restore the core of the natural water system (National Research Council 1992, Mitsch and Gosselink 1993, Oliver et al. 1997) as much as possible within the constraints of the human disturbance landscape (including water diversions). The river needs to return to a more natural hydrologic regime. This is a major objective of the Cosumnes River Preserve Project, which has been implemented on the Preserve and should be extended along the length of the river and to other rivers and creeks.

The Preserve project is one of the foremost regional demonstration experiments in the Central Valley, because it implements and demonstrates the most important solution to our degraded watersheds. The Preserve project includes two additional landuse practices that are related to restoring the river floodplain: vegetating farm ditches, which are highly degraded creeks, with native plant communities, and developing ecosystem-compatible organic rice farming around the restored river and sloughs (vegetated farm ditches).

C. Regional Demonstration Experiments

Implementing restoration solutions and demonstrating their success to as much of the regional community as possible is fundamental to the objectives of the ERPP. During the 1996 floods, the Sacramento County community watched the Preserve flood with little negative impacts, and recognized the value of widening the river and surrounding it with river-friendly and flood-compatible land use.

There is no comparable large-scale river restoration project or regional demonstration experiment in the Monterey Bay area. When the Pajaro Valley was flooded in 1995, the Santa Cruz long-toed salamander and riparian trees were blamed for the flood because the river is habitat for the endangered salamander and prevented flood agencies from removing trees in the narrow, diked channel. The river would have flooded with or without tree removal. The dikes collapsed in three locations where the straightened and confined channel crossed the old natural river bed. Flood water flowed under the dikes into the old river sediments causing the dikes to liquefy with catastrophic failure. Over 95% of the flood damage was caused by one major barrier to flood retreat, Highway 1. Flood water ponded behind the highway for months, the town of Pajaro was flooded for the first time, and over a foot of silt was deposited on farm land behind the highway. The newspapers, politicians, most farmers, and most of the public still do not understand why this happened.

The Salinas Valley has no similar barrier to flood retreat, and most flood waters retreated into the river channel within 12 hours. Nevertheless, the new county plan for the river is to dig deeper ditches and make higher dikes. If our region had a demonstration experiment comparable to the Preserve, we would be making plans and taking action to restore our rivers by letting them flow and spread more naturally, and we would be planning to remove or reduce barriers to flood retreat.

Regional demonstration experiments are needed for any key solution to important ecological problems. This should be the first principal of applied ecology. The Central Valley has the Cosumnes River Preserve.

D. Documenting Results

The results/progress/success of regional demonstration experiments need to be documented and disseminated to the broadest possible public audience. The general objective of this proposal is to document the improvement in habitat quality and native ecosystems in the three large-scale landuse experiments in the Preserve. We will document changes in water quality as an important component of habitat improvement. We will also document changes in sedimentary habitats as part of a more general characterization of aquatic habitats. These changes in the physical and chemical habitat characteristics will be compared to changes in aquatic ecosystems in the three landuse experiments. Benthic invertebrate communities will be used as the first indicator of ecosystem development and health. They will be compared to ongoing sampling of fishes, birds and riparian plants.

Our general hypothesis is that the three landuse strategies/experiments on the Preserve result in significant positive improvements in fresh water habitats and ecosystems. The first step in public education is to present our final report as a website that can be expanded and made available to a large audience. The success of Cosumnes Preserve must be shown to as many people as possible. It is the best restoration project in the CALFED study area, and an excellent example for future river restoration in the Monterey Bay area and for many other regions as well.

E. Linkages

The most important linkage to the proposed project is with the past, ongoing, and future ecosystem restoration and other land management strategies/experiments on the Cosumnes River Preserve. Without the Nature Conservancy's river restoration and management practices on the Preserve, there would be no need for this proposal. This linkage is fundamental. The proposed project evaluates and documents the success of land management actions that restore a more natural hydrologic regime to the Cosumnes River and wetland habitats of its lower floodplain. The multi-agency effort to restore and protect the Cosumnes River ecosystem through levee removal, improved land management practices, riparian and wetland restoration, and the elimination of fish passage problems directly complements efforts undertaken by the ERP to restore the ecological health of the Cosumnes River Ecological Unit and the bay-delta watersheds.

The proposed project also links directly to a number of complementary research monitoring studies of other components of the Preserve ecosystem. Linking to these studies will provide a more complete evaluation of the habitat quality and ecosystem development and health related to the three landuse experiments that are the main focus of the proposed project, especially in the seasonally flooded river habitats. The complementary investigations include: 1) California State University Sacramento - a study of larval fish use of winter flooded bottomlands; 2) Fisheries Foundation of California - a survey of fish in the flooded fields; 3) California Department of Fish & Game - an inventory of fish and herptiles in the Cosumnes River Watershed; 4) Ducks Unlimited - a project comparing waterfowl use and diets of birds using managed seasonal wetlands and of birds using the organic rice fields; 5) Point Reyes Bird Observatory - a project measuring song-bird breeding success in the floodplain habitat; and, 6) California Department of Fish & Game - assessment of aquatic macro-invertebrates in the Cosumnes River adjacent to the Preserve.

Another important linkage of the proposed work is to the programs at the Watershed Institute (TWI) at California State University Monterey Bay. Moss Landing Marine Laboratories is a founding partner of TWI, and is also the marine science department at California State University Monterey Bay. All of our restoration projects, including the work proposed here for the Cosumnes River, are done in partnership with TWI, which spearheads regional efforts to restore watersheds, monitor progress and success, and influence policy through the political process and public education programs such as our adopt a watershed project, the "Return of the Natives." In the last 5 years, TWI has implemented a complete range of watershed restoration demonstration projects (over 30 project sites highlighted on TWI website) from the coastal dunes to the top of the watershed in the Salinas Valley, except for one critical restoration strategy/experiment. We have not been able to open dikes along the major rivers of the Salinas and Pajaro Valleys. Although dikes have been opened along the lower Carmel River in our neighborhood, the Cosumnes River Preserve Project is the best example of this essential ecosystem restoration strategy in large agricultural landscapes, like the Central Valley and the Salinas and Pajaro Valleys.

CDFG Mussel Watch and Marine Pollution Laboratory are located at Moss Landing Marine Labs and also are founding partners of TWI. The ecosystem sampling and particularly the water quality work proposed here was developed on TWI restoration sites, with our local CDFG labs. In addition, the marine lab and other TWI partners, CDFG Water Pollution Control Laboratory in Sacramento (Jim Harrington), and the Central Coast Regional Water Quality Control Board are conducting a joint study to develop a rapid bioassessment protocol to characterize, score and evaluate boatable river habitats and lagoons.

The proposed project helps to document the achievement of ERP's strategic objectives and targets for habitat and hydrologic improvement on the lower Cosumnes River. Our results can be applied to numerous other systems within the bay-delta, its tributary watersheds, and beyond.

Monitoring the progress or success of the Preserve restoration and landuse experiments is directly related to ERP's ecological processes and implementation objectives for the restoration of Central Valley streamflows (ERP vol I, p.16); visions for the Cosumnes River ecological unit (ERP vol II, pp. 346 and 348); and programmatic objectives to restore the hydrologic function of the Cosumnes River and restore wetland and riparian habitats (ERP vol II, p. 258).

F. System-Wide Ecosystem Benefits

This proposal complements all projects in the Bay-Delta watershed as well as other flood-plain and low-land habitats that rely upon water quality and habitat information in order to judge: a) the potential of a watershed or site for fish restoration, b) the effectiveness of restoration programs in achieving the goal of habitat improvement, and, c) the effectiveness of restoration programs or land management practices (in this case, removing levees to open historically occurring floodplains and wetlands and organic rice farming) in achieving the goal of water quality improvement. The project directly enhances the currently funded project to develop rapid bioassessment protocols for lagoons and boatable waters in California's central coast and other efforts to develop protocols for non-stream systems. The information obtained by this project will augment the state biological database and GIS to characterize and monitor wetland and riparian habitats.

G. Compatibility with Non-Ecosystem Objectives

The Preserve project is the best management practice for restoring the core of the natural water system which maximizes all water resource values or ecosystem services. In addition to restoring river and other wetland ecosystems, the project is the most ecologically and economically sound flood protection. The developing wetland filters are the best way to clean up drainage water from farms and probably the most positive action we can take at present to combat non-point source pollution. Surface waters can be stored in the expanded river habitats, at the scale done by beavers, and reused for farm irrigation in the future. The increase in surface water retention in the expanded wet corridors increases positive pressure at all potential ground water recharge areas along the wet corridor: more water is present for longer periods of time.

IV. Technical Feasibility and Timing

There are no CEQA, NEPA or other environmental compliance documents necessary for this project. No permits need to be in place other than existing verbal agreements with the managers of the Cosumnes River Preserve.

V. Monitoring and Data Collection Methodology

A. Ecological Objectives

The restoration of wet corridors is the most important action that we can take to improve water quality and ecological function in multiple habitats throughout the state, and particularly along the drainages into the bay-delta system. Naturally vegetated rivers, creeks, and marshes are excellent, cost-effective water pollution filters (Hammer and Bastian 1989, Gearheart 1992, Hupp et al. 1993, Puckett et al. 1993, Mitsch and Gosselink 1993). Wetland vegetation, including rice rhizomes, creates a thick ecological sponge which physically filters sediment and organic-mineral aggregates from surface water, while microorganisms that live on plant surfaces and in the sediment capture, degrade and recycle many chemicals. We expect the recovering native vegetation of the seasonal wetlands to alter physically and chemically the quality of the water flowing over it. Likewise, we expect the rice fields and the native vegetation of the sloughs to do the same. Using several sampling sites within each habitat we will directly measure multiple parameters of water quality and general habitat quality. We will measure the health of the ecosystem by sampling benthic invertebrate communities. Water quality and habitat condition are vital to the fishes living there. To further define the quality of fish habitat we will sample the plankton community in the flooded wetlands. We will maintain a flexible sampling regime to take advantage of rainfall events and to coordinate with other ongoing research within the Preserve, particularly fish sampling. Our proposed monitoring program will be carried out for three years.

B. Monitoring Parameters and Data Collection Approach

Suspended sediments (turbidity) and nitrates are the best indicators of water quality improvement from filtering farm drainage water through more naturally vegetated habitats. They can indicate sites that may contain higher levels of pesticides, herbicides, and metals that can be sampled in sediments, in the tissues of native species, or in the tissues of freshwater clams in a mussel watch protocol. In the dry seasons, the sloughs and rice areas in the Preserve are influenced by delta waters with lower water quality, which will also be indicated by other water quality parameters like salinity and dissolved oxygen. The multi-channel water quality probe measures turbidity, conductivity, temperature, dissolved oxygen and pH in the field. Nitrates and phosphates will be measured in the laboratory directly after collection of water samples in the field. We will measure a number of other habitat conditions including sediment grain size and organic carbon, plant and other debris, plant cover, flow patterns and other hydrology, and plankton communities over the flooded river habitats.

Benthic communities will be sampled using a wide variety of techniques during the early sampling periods to develop the most appropriate techniques for the Preserve. Rapid bioassessment sampling protocols are only developed for shallow, running water in coarse deposits, where surface active and nestling animals are primarily collected. The Preserve habitats are deeper, water does not flow fast, and finer depositional environments are common. Infaunal animals are likely to be much more abundant, and surface active and nestling animals will also be present. We will compare the running water sampling protocols, variations on these, and other sampling techniques such as cores of finer deposits to develop the best quantitative description of benthic communities. We will then develop a sampling protocol that can be used for rapid bioassessment in these more ponded habitats. The protocol will depend also on the selection of metrics by establishing relationships between benthic population and community parameters and disturbance gradients (habitat quality).

C. Data Evaluation Approach

We will evaluate relationships between habitat quality and benthic communities with graphical comparisons of descriptive statistics, with formal pattern searching analyses (cluster analysis and other multi-variate approaches), and with inferential statistics where appropriate. We will also investigate relationships between habitat quality, benthic communities, and fish populations (sampled by other groups in the Preserve). Table 2 defines the biological/ecological objectives and Table 3 outlines these analytical approaches for the different types of sampling. Karr and Chu (1999) describe the approach for developing multi-metric indices, which involves much of the same natural history and data evaluation.

VI. Local Involvement

All work will be done on the Cosumnes River Preserve, which is managed by the Nature Conservancy and jointly owned by the following private and public agencies:

- Bureau of Land Management
- California Department of Fish and Game
- California Department of Water Resources
- Ducks Unlimited, Inc.
- Sacramento County Department of Regional Parks, Open Space, and Recreation
- The Nature Conservancy of California
- Wildlife Conservation Board

Since its inception ten years ago, the Cosumnes River Preserve has built a strong outreach program which is aimed at educating the public and creating hands-on opportunities for all ages. Last year nearly 28,000 people visited the Preserve. The Preserve has regularly scheduled, well-attended volunteer work groups where participants spend the day actively restoring riparian habitats, including oak groves, and cottonwood forests. They also may demolish buildings and other structures, remove exotic species, or help with species counts. Volunteers lead tours,

I-014207

Table 2. Biological/ Ecological Objectives

Hypothesis/Question to be Evaluated	Monitoring Parameter(s) & data collection approach	Data evaluation approach	Comments/ data priority
Efforts of CRP to restore a more natural hydrologic regime of the lower Cosumnes River and floodplains will result in improved water quality, and habitat for fishes, and other vertebrates and invertebrates.	Parameter 1) Water quality: water is both sampled on site for dissolved oxygen, pH, conductivity, turbidity, temperature, and in the lab for nitrates and phosphates.	Data will be entered into a database and evaluated with respect to station, habitat, treatment, season, rain events and year.	1
	Parameter 2) Biosurvey of benthic invertebrates: identify and quantify species abundance, combine with assessment site and grain size data to commence the development of a standardized protocol for quantifying the quality of the habitat.	Invertebrate data will be entered into a database and analyzed for application in future standardized bioassessment protocols.	2
	Parameter 3) Site characterization	Flow regime, depth, vegetation, grade, and other standard parameters will be analyzed for habitat value.	3
	Parameter 4) Grain size: collect and analyze sediments for grain size characteristics.	Data will be analyzed for all size fractions and combined with site characterization and invertebrate samples for future standardized bioassessment protocols.	4
	Parameter 5) Plankton tows: survey plankton communities in flooded habitats.	Plankton will be counted and identified to lowest taxon with respect to station, season and rainfall.	5

Table 3. Data Evaluation Approach

Sample Type	Samples per year	Sample Handling	Analytical Techniques	Data Synthesis and Analysis	References
water quality analysis (field)	160	n/a	multi-channel water quality probe for DO/pH/temp/conductivity /turbidity	water quality parameters compared within and between habitats using multi-variate statistics	Solomat multi-channel water quality probe procedures Biostatistical Analysis, Zar, J.H., 1984. Prentiss Hall
water quality analysis (lab)	160	sterile jars kept in refrigerated container	colorimetric analyses of nitrates and phosphates	see above	Statistics, see above Strickland & Parsons, 1972
grain size analysis(lab)	120	collected and transported in jars	sieve analysis for coarse fraction, hydrometer analysis for fine fraction	grain size parameters compared within and between habitats using fractional percents	Folk, R.L. Petrology of Sedimentary Rocks. 1974.
infaunal cores for invertebrate bioassessment (field)	120	cored samples are placed in plastic baggies, and transported to the lab in refrigerated containers; preserved in alcohol	sorting, identification to lowest possible taxon and list abundances of species.	assign species into trophic and tolerance groups; correlate to within and between-treatment habitat assessment categories	USEPA Rapid Bioassessment Protocols for use in streams and rivers. EPA/440/4-89/001. 1989. Thorp, J.H. & Covich, A.P. 1991. Ecology and Classification of N. American Freshwater Invertebrates.
habitat characterization for bioassessment (field)	120	n/a	develop scoring criteria	observations of sites will be combined with invertebrate data to augment the appropriate habitat categorization protocols	USEPA Rapid Bioassessment Protocols for use in streams and rivers. EPA/440/4-89/001. 1989.
plankton tows (field/lab)	30	placed in jars; preserved in alcohol	identify, and quantify species abundance	see above	Thorp, J.H. & Covich, A.P. 1991. Ecology and Classification of N. American Freshwater Invertebrates

I-014209

including walking, driving and kayaking, and regularly host school programs from their visitors' center. They also have the opportunity to work directly with scientists, assisting them as they collect data throughout the Preserve. Nearly 7000 work hours were donated by volunteers last year.

The most direct county government involvement with the Preserve is through the parks and schools, but includes a much wider range of groups from public works, planning, flood and water resources, to the supervisors. The Preserve has steadily expanded through diverse partnerships over the decade, where adjacent private landowners, mostly farmers, have been important and willing partners. Preserve managers inform local landowners and stakeholders of river and floodplain restoration and management activities. The key to these relationships is to treat Preserve landuse activities as demonstration projects and provide public access through the formal and informal education programs.

The results of the proposed project include an integrated evaluation of the ecological success of the Preserve landuse experiments, particularly on aquatic habitats and ecosystems from plants and benthic invertebrates to fishes and birds. These results will be incorporated into the Watershed Institute website and linked to the Preserve site and other appropriate web sites. These links will garner more and more local involvement and spread these outstanding, sustainable landuse and watershed restoration practices to a large and larger local community.

VII. Cost

The total budgeted cost requests are presented in Table 4, with task budgeted costs for each year in Tables 5-7. Table 8 defines the budget by quarter. Project management will include costs associated with time planning and implementing scheduled field, laboratory and office functions as well as costs necessary to prepare for and travel to meetings with Calfed, Preserve, other state and private agencies and entities in order to ensure cooperation and the dissemination of data and information for the successful completion of the project.

The 47% indirect cost rate is the San Jose State University Foundation's federally-negotiated rate for use on grants, contracts and other agreements for on-campus research. The base equals total direct costs excluding capital expenditures, that portion of each subaward in excess of $25,000, participant support costs, student tuition remission and student support costs.

San Jose State University Foundation does not have a separate indirect cost rate for State-funded grants and contracts.

The schedule identifying the start and completion dates for specific tasks discussed above is presented in Figure 3.

VIII. Cost Sharing

The most important cost sharing is provided by the Nature Conservancy programs and their exemplary partnerships. They planned and implemented the landuse and ecosystem restoration experiments that we propose to monitor and they will maintain them into the future. The commitment of TNC is well documented by the last decade of success and growth on the landscape and in their diverse partnerships. They are also continually planning to expand this outstanding work, beginning with land acquisitions and agreements and moving into restoration and other ecosystem friendly landuse to public education. This is critical cost sharing. TNC's annual budget for the Preserve is about a million dollars. Below we list cost sharing projects that are directly related to the research monitoring we propose.

Source	Activities	Amount $	
Dept. Water Resources	Water quality and bioassessment development	40,000	1
Moss Landing Marine Labs	Water quality and bioassessment development	25,000	1
The Watershed Institute	Water quality and bioassessment development	10,000	1

Figure 3 . Schedule of tasks. This represents the first and second year: third year we will terminate sampling in July to allow time for final report writing.

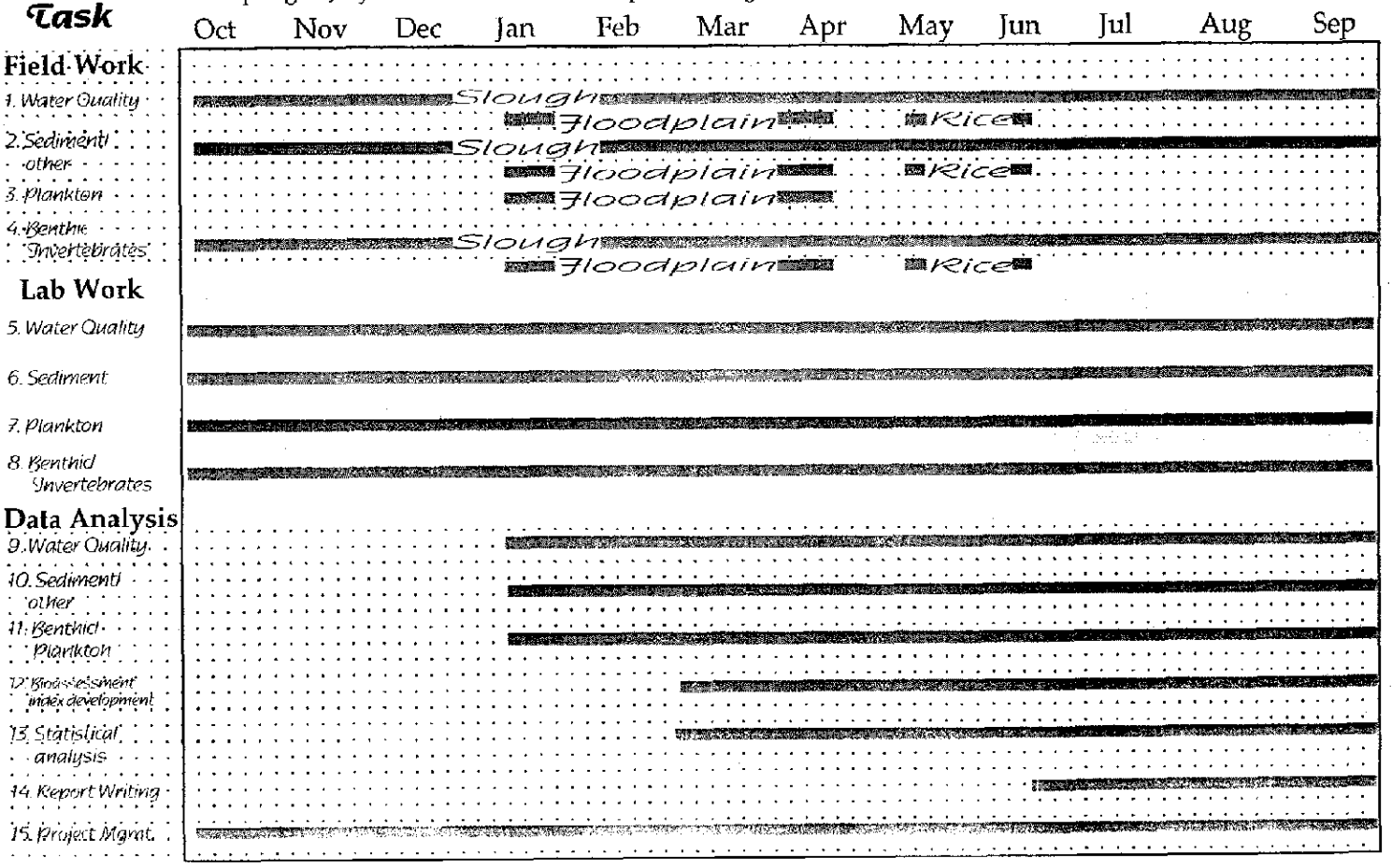


Table 4. Total Budget

	# stations	times/ year	total samples	person hrs/ station	total hours	hourly rate	Cost
COSTS PER YEAR							
DIRECT COSTS							
LABOR							
Field Work							
Water Quality	16	10	160	3	480	$25	$12,000
Bioassessment	12	10	120	5	600	$25	$15,000
Plankton Tows	3	10	30	6	180	$25	$4,500
Lab Work					# samples	cost/samp	
Water Quality					160	$120	$19,200
Bioassessment					120	$150	$18,000
Plankton Tows					30	$75	$2,250
Grain Size Analysis					120	$40	$4,800
					total hours	hourly rate	Cost
Data Analysis					240	$25	$6,000
Data Presentation/Reporting					100	$50	$5,000
Project Management/Contacts/Meetings					100	$50	$5,000
BENEFITS (on labor)						5.00%	$4,588
TRAVEL/OVERNIGHTS							$4,000
SUPPLIES							$2,500
EQUIPMENT							$9,400
BOAT/GAS							$1,500
TOTAL DIRECT COSTS							$113,738
INDIRECT COSTS						47.00%	$53,457
ANNUAL COST							$167,194

TOTAL BUDGET	
YEAR 1	$167,194
YEAR 2	$159,511
YEAR 3	$165,892
3 Year Budget	$492,597

Annual budgets increase by 4% per year
Years 2 and 3 do not contain the equipment line item.

I-014212

Table 5. Task Budget Year One

Task	Direct Labor Hours	Direct Salary and Benefits	Service Contracts	Material and Acquisition Costs	Miscellaneous and other Direct Costs	Overhead and Indirect Costs
Task 1.1 Field Work: Water Quality	480	$12,600		$1,000		$6,392
Task 1.2 Field Work: Bioassessment	600	$15,750		$8,200	$750	$11,609
Task 1.3 Field Work: Plankton Tows	180	$4,725		$2,700	$750	$3,842
Task 2.1 Lab Work: Water Quality		$20,160			$1,350	$10,110
Task 2.2 Lab Work: Bioassessment		$18,900			$1,350	$9,518
Task 2.3 Lab Work: Plankton Tows		$2,363			$1,300	$1,721
Task 2.4 Lab Work: Grain Size Analysis	120	$5,040				$2,369
Task 3. Data Analysis	240	$6,300				$2,961
Task 4. Data Presentation/Reporting	100	$5,250				$2,468
Project Management/Contacts/Meetings	100	$5,250				$2,468
SUBTOTALS		$96,338	$0	$11,900	$5,500	$53,457
TOTAL						$167,194

I-014213

Table 6. Task Budget Year Two

Task	Direct Labor Hours	Direct Salary and Benefits	Service Contracts	Material and Acquisition Costs	Miscellaneous and other Direct Costs	Overhead and Indirect Costs
Task 1.1 Field Work: Water Quality	480	$13,104		$1,040		$6,648
Task 1.2 Field Work: Bioassessment	600	$16,380		$1,248	$780	$8,652
Task 1.3 Field Work: Plankton Tows	180	$4,914		$312	$780	$2,823
Task 2.1 Lab Work: Water Quality		$20,966			$1,404	$10,514
Task 2.2 Lab Work: Bioassessment		$19,656			$1,404	$9,898
Task 2.3 Lab Work: Plankton Tows		$2,457			$1,352	$1,790
Task 2.4 Lab Work: Grain Size Analysis	120	$5,242				$2,464
Task 3. Data Analysis	240	$6,552				$3,079
Task 4. Data Presentation/Reporting	100	$5,460				$2,566
Project Management/Contacts/Meetings	100	$5,460				$2,566
SUBTOTALS		$100,191	$0	$2,600	$5,720	$51,000
TOTAL						$159,511

I-014214

Table 7. Task Budget Year Three

Task	Direct Labor Hours	Direct Salary and Benefits	Service Contracts	Material and Acquisition Costs	Miscellaneous and other Direct Costs	Overhead and Indirect Costs
Task 1.1 Field Work: Water Quality	480	$13,628		$1,082		$6,914
Task 1.2 Field Work: Bioassessment	600	$17,035		$1,298	$811	$8,998
Task 1.3 Field Work: Plankton Tows	180	$5,111		$324	$811	$2,936
Task 2.1 Lab Work: Water Quality		$21,805			$1,460	$10,935
Task 2.2 Lab Work: Bioassessment		$20,442			$1,460	$10,294
Task 2.3 Lab Work: Plankton Tows		$2,555			$1,406	$1,862
Task 2.4 Lab Work: Grain Size Analysis	120	$5,451				$2,562
Task 3. Data Analysis	240	$6,814				$3,203
Task 4. Data Presentation/Reporting	100	$5,678				$2,669
Project Management/Contacts/Meetings	100	$5,678				$2,669
SUBTOTALS		$104,199	$0	$2,704	$5,949	$53,040
TOTAL						$165,892

I-014215

Table 8. Quarterly Budget

Task	Year One: Oct-Dec 99	Jan-Mar 00	Apr-Jun 00	Jul-Sep 00	Year Two: Oct-Dec 00	Jan-Mar 01	Apr-Jun 01	Jul-Sep 01	Year Three: Oct-Dec 01	Jan-Mar 02	Apr-Jun 02	Jul-Sep 02
Task 1.1 Field Work: Water Quality	$4,998	$4,998	$4,998	$4,998	$5,198	$5,198	$5,198	$5,198	$5,406	$5,406	$5,406	$5,407
Task 1.2 Field Work: Bioassessment	$9,077	$9,077	$9,077	$9,078	$6,765	$6,765	$6,765	$6,765	$7,035	$7,035	$7,035	$7,037
Task 1.3 Field Work: Plankton Tows	$3,004	$3,004	$3,004	$3,004	$2,207	$2,207	$2,207	$2,208	$2,295	$2,295	$2,295	$2,297
Task 2.1 Lab Work: Water Quality	$7,905	$7,905	$7,905	$7,905	$8,221	$8,221	$8,221	$8,221	$8,550	$8,550	$8,550	$8,550
Task 2.2 Lab Work: Bioassessment	$7,442	$7,442	$7,442	$7,442	$7,739	$7,739	$7,739	$7,741	$8,049	$8,049	$8,049	$8,049
Task 2.3 Lab Work: Plankton Tows	$1,346	$1,346	$1,346	$1,346	$1,399	$1,399	$1,399	$1,402	$1,455	$1,455	$1,455	$1,458
Task 2.4 Lab Work: Grain Size Analysis	$1,852	$1,852	$1,852	$1,852	$1,926	$1,926	$1,926	$1,928	$2,003	$2,003	$2,003	$2,004
Task 3. Data Analysis	$2,315	$2,315	$2,315	$2,316	$2,407	$2,407	$2,407	$2,410	$2,504	$2,504	$2,504	$2,505
Task 4. Data Presentation/Reporting	$1,929	$1,929	$1,929	$1,931	$2,006	$2,006	$2,006	$2,008	$2,086	$2,086	$2,086	$2,089
Project Management/Contacts/Meetings	$1,929	$1,929	$1,929	$1,931	$2,006	$2,006	$2,006	$2,008	$2,086	$2,086	$2,086	$2,089
SUBTOTALS	$41,797	$41,797	$41,797	$41,803	$39,874	$39,874	$39,874	$39,889	$41,469	$41,469	$41,469	$41,485
THREE YEAR TOTAL												$492,597

RWQCB- REG 3	Water quality and bioassessment development	40,000	2
Fisheries Foundation/TNC	Diversity and abundance of fishes in flooded habitat	10,000	3
CSU Sacramento/TNC	Larval fish use of the flooded bottomlands	5,000	3
UC Davis/TNC	Plant communities of the Preserve flooded habitat	40,000	4

1 = funded, 2 = pending, 3 = past and/or ongoing projects that will continue

IX. Applicant Qualifications

Dr. John Oliver is the project director and principal investigator. He will oversee all aspects of the proposed study with a project manager. He has been an Adjunct Professor at Moss Landing Marine Laboratories (MLML) and the director of research projects at the MLML Benthic Lab for the past 20 years; and the Restoration Coordinator at the Watershed Institute since he helped found it at California State University Monterey Bay in 1995. He is the MLML project co-director (with Mark Stephenson who is the Director) for the CDFS Marine Pollution Study Group for almost a decade. He has therefore directed several millions of dollars of reseach grants and contracts, including over a decade of NSF grants for benthic disturbance ecology in coastal environments. He spearheads the design, implementation, and support of water quality and ecosystem monitoring for the Watershed Institute restoration projects in freshwater habitats of the Monterey Bay area (see TWI website). He also helped design, implement, and support the longest ongoing water quality sampling in our regional watersheds at the Elkhorn Slough Foundation, including local TNC lands. He has world wide experience in benthic marine communities, especially how they respond to natural and anthropogenic disturbances. He developed a benthic disturbance index during the state's bay protection program which correlated well with sediment contamination. This process brought his lab into partnership with CDFG Water Pollution Control Laboratory (Jim Harrington) exploring benthic invertebrate communities in coastal watersheds and developing rapid bioassessment techniques as described in the proposal. His marine and estuarine disturbance studies parallel the freshwater natural history which is the foundation of the rapid bioassessment approach. In addition to developing rapid bioassessment protocols for non-running, more ponded waters, his group is working on brackish protocols as well.

Jim Harrington is a project co-investigator who was instrumental in attracting Moss Landing Marine Lab staff and students into freshwater benthic communities. He will be involved in all aspects of the benthic invertebrate sampling and rapid bioassessment development. He helped initiate a joint program with the marine lab and RWQCB to sample for the first time the benthic communities in the rivers of the Monterey Bay area. Jim spearheads the benthic community studies at the CDFG Water Pollution Control Laboratory near Sacramento, which designs and conducts monitoring programs throughout California. He is involved with developing rapid bioassessment protocols for California, organizing the California Aquatic Bioassessment Workgroup, and designing and conducting bioassessment investigations of point and non-point sources of pollution and enforcement of Fish and Game code 5650. He has extensive experience in water quality, aquatic toxicity testing, stream gravel quality assessment, aquatic habitat measurements, and aquatic biota surveys used to assess status and damage and to monitor recovery of aquatic systems.

Dr. Steven Morgan is a project co-investigator who will supervise the plankton studies and assist and advise staff and students on all aspects of ecology. He is an Associate Professor with joint appointments in the Department of Environmental Science and Policy and Bodega Marine Laboratory at UC Davis. Morgan specializes in plankton and studies population and community ecology, behavioral ecology, evolution of life histories, biogeography, global change and conservation biology. His research interests concern the physical, chemical and biological processes that regulate the timing of reproduction, larval dispersal and larval settlement; and how

predation and other selective forces shape animal life histories. His past work has focused in coastal marine environments, but his new position at Davis places him in a excellent location to explore the bay-delta systems.

Dr. Kenneth Coale is a project co-investigator who will help with laboratory quality control, evaluation, and analysis of water and sediment chemistry. He has ongoing and past projects exploring sediment chemistry in the bay-delta system, and will relate results from the proposed project to his other work. He will also advise graduate students with their master's thesis work, which we plan to work into the project. He is the Acting Director of Moss Landing Marine Laboratories with extensive experience in marine and coastal sediment and water chemistry, and particularly with trace metal biogeochemistry (25 years). For the last 10 years, Dr. Coale has received funding from the National Science Foundation and the Office of Naval Research to study the processes which control the flux of toxic metals and nutrients between the sediments and overlying waters of the LA/Long Beach, San Francisco Bay, and continental coastal margin systems using benthic flux chambers and sediment porewater modeling. He has also helped direct important experiments in biogeochemistry concerning the role of iron in global productivity.

Dr. Rich Reiner is the Director of Research at the Cosumnes River Preserve. He is moving to a Nature Conservancy project in northern California and a replacement will be selected soon. This person will take over Dr. Reiner's role at the Preserve and coordinate with our project on the Preserve. This proposal is a direct outcome of Rich's encouragement, competent assistance, and constant support. He has developed and coordinated past research work on the Preserve, including the plant, bird, and fish work that is part of the ecosystem evaluation we propose. More important, he is central to implementing, maintaining, and expanding the outstanding restoration experiments and education programs which are the Preserve.

Dr. Robert Curry is a project co-investigator who will help in characterizing the quality of the aquatic habitats at the study sites, in quantifying these measures, and in advising staff and graduate students. He is Professor Emeritus at the University of California Santa Cruz and the Research Director at the Watershed Institute. He is a hydrologist and ecologist with extensive experience in watershed management, restoration, and other applied watershed science.

Mark Stephenson is a project co-investigator. His group's role is small but critical as they helped developed the water quality and sediment sampling for the watersheds of the Monterey Bay area as a founding member of the Watershed Institute. Mark is the Director of CDFG Marine Pollution Study Group, which has spearheaded the monitoring and evaluation of water and sediment contamination in marine and estuarine environments along the entire California coast. They also have active research programs involving trace metals in sediments of the bay-delta system. His group is helping with the development of rapid bioassessment protocols through the RWQCB, particularly with the description of environmental disturbance gradients used to define metrics for the multi-metric indices. He is invaluable at guiding and supporting graduate students working on the ecosystem impacts of anthropogenic chemicals in water and sedimentary habitats, and will continue this role with staff and students in the proposed project.

X. Compliance with Standard Terms and Conditions.

This project is in compliance with standard terms and conditions. See attached documents.

XI. Cited Literature

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Puckett, L.J., M.D. Woodside, B. Libby, and M.R. Schening. 1993. Sinks for trace metals, nutrients, and sediments in wetlands of the Chickahominy River near Richmond, Virginia. Wetlands 13: 105-114.

Runnels, C. 1995. Environmental degradation in ancient Greece. Scientific American. March 1995.

ATTACHMENT D AND E FORMS

I-014220

STATE OF CALIFORNIA
NONDISCRIMINATION COMPLIANCE STATEMENT
STD. 19 (REV. 3-95) FMC

COMPANY NAME
San Jose State University Foundation

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME
Nabil Ibrahim N. Ibrahim

DATE EXECUTED	EXECUTED IN THE COUNTY OF
4/15/99	Santa Clara

PROSPECTIVE CONTRACTOR'S SIGNATURE

PROSPECTIVE CONTRACTOR'S TITLE
Acting AVP, Graduate Studies and Research

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME
San Jose State University Foundation

State of California
The Resources Agency
Department of Water Resources

Agreement No. _____

Exhibit _____

NONCOLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID FOR PUBLIC WORKS

STATE OF CALIFORNIA)
)ss
COUNTY OF Santa Clara)

Nabil Ibrahim (name), being first duly sworn, deposes and says that he or she is Acting AVP, Graduate Studies & Research (position title) of San Jose State University Foundation (the bidder).

the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

DATED: 4/15/99

By N. Ibrahim
(person signing for bidder)

MARY B. MIKOS
Commission # 1210997
Notary Public - California
Santa Clara County
My Comm. Expires Mar 15, 2003

(Notarial Seal)

Subscribed and sworn to before me on April 15, 1999

Mary B. Mikos
(Notary Public)

STATE OF CALIFORNIA)
)ss
COUNTY OF Santa Clara)

DWR 4206 (New 4/90)

OMB Approval No. 0348-0043

APPLICATION FOR FEDERAL ASSISTANCE

2. DATE SUBMITTED	Applicant Identifier
4/15/99	
3. DATE RECEIVED BY STATE	State Applicant Identifier
4. DATE RECEIVED BY FEDERAL AGENCY	Federal Identifier

1. TYPE OF SUBMISSION

Application	*Preapplication*
☐ Construction	☐ Construction
☒ Non-Construction	☐ Non-Construction

5. APPLICANT INFORMATION

Legal Name: San Jose State University Foundation

Organizational Unit: Moss Landing Marine Laboratories

Address *(give city, county, state, and zip code)*:
P. O. Box 720130
San Jose, CA 95172-0130

Name and telephone number of person to be contacted on matters involving this application *(give area code)*
Technical: John Oliver 831-633-7250
Contractual: Carol Sooter 408-924-1430

6. EMPLOYER IDENTIFICATION NUMBER (EIN): 94 – 6017638

7. TYPE OF APPLICANT: *(enter appropriate letter in box)* N

A. State
B. County
C. Municipal
D. Township
E. Interstate
F. Intermunicipal
G. Special District
H. Independent School Dist.
I. State Controlled Institution of Higher Learning
J. Private University
K. Indian Tribe
L. Individual
M. Profit Organization
N. Other (Specify) Nonprofit Auxiliary to SJSU

8. TYPE OF APPLICATION:

☒ New ☐ Continuation ☐ Revision

If Revision, enter appropriate letter(s) in box(es): ☐ ☐

A. Increase Award B. Decrease Award C. Increase Duration
D. Decrease Duration Other *(specify)*:

9. NAME OF FEDERAL AGENCY:

Department of Interior

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER:

TITLE: CALFED Delta-Bay Program

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT:

Ecosystem Development at the Cosumnes River Preserve: Model Restoration Experiments for the Central Valley and Beyond

12. AREAS AFFECTED BY PROJECT *(cities, counties, states, etc.)*:

Sacramento County

13. PROPOSED PROJECT: Start Date	Ending Date	14. CONGRESSIONAL DISTRICTS OF: a. Applicant	b. Project
10/1/99	9/30/02	16	11

15. ESTIMATED FUNDING:

a. Federal	$	$492,597.00
b. Applicant	$	.00
c. State	$	.00
d. Local	$	.00
e. Other	$	.00
f. Program Income	$	.00
g. TOTAL	$	$492,597.00

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?

a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:

DATE _____

b. NO. ☒ PROGRAM IS NOT COVERED BY E.O. 12372

☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT?

☐ Yes If "Yes," attach an explanation. ☒ No

18. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT. THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED.

a. Typed Name of Authorized Representative	b. Title	c. Telephone number
Nabil Ibrahim	Acting AVP, Graduate Studies and Research	408-924-2488

d. Signature of Authorized Representative: N. Ibrahim

e. Date Signed: 4/15/99

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Standard Form 424 (REV. 7-97)
Prescribed by OMB Circular A-102

I –014223

I-014223

ASSURANCES - NON-CONSTRUCTION PROGRAMS

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee 3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL	TITLE
N Ibrahim	Acting AVP, Graduate Studies and Research
APPLICANT ORGANIZATION	DATE SUBMITTED
San Jose State University Foundation	4/15/99

Standard Form 424B (Rev. 7-97) Back

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I-014225

OMB Approval No. 0348-0044

BUDGET INFORMATION - Non-Construction Programs

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Bay-Delta Program		$	$	$ $167,194	$	$167,194
2.						$0
3.						$0
4.						$0
5. TOTALS		$0	$0	$167,194	$0	$167,194

SECTION B - BUDGET CATEGORIES

6. OBJECT CLASS CATEGORIES	GRANT PROGRAM, FUNCTION OR ACTIVITY (1) Bay-Delta Program	(2)	(3)	(4)	Total (5)
a. Personnel	$ $91,750	$	$	$	$91,750
b. Fringe Benefits	$4,588				$4,588
c. Travel	$4,000				$4,000
d. Equipment	$9,400				$9,400
e. Supplies	$2,500				$2,500
f. Contractual					$0
g. Construction					$0
h. Other	$1,500				$1,500
i. Total Direct Charges (sum of 6a-6h)	$113,738				$113,738
j. Indirect Charges	$53,457				$53,457
k. TOTALS (sum of 6i and 6j)	$167,195				$167,195
7. PROGRAM INCOME	$0	$0	$0	$0	$0

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SECTION C - NON FEDERAL RESOURCES				
(a) Grant Program	(b) Applicant	(c) State	(d) Other sources	(e) TOTALS
8. Bay-Delta Program	$0	$0	$0	$0
9.				$0
10.				$0
11.				$0
12. TOTALS (sum of lines 8 and 11)	$0	$0	$0	$0

SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$167,194	$41,799	$41,799	$41,799	$41,799
14. NonFederal	$0	$0	$0	$0	$0
15. TOTAL (sum of lines 13 and 14)	$167,194	$41,799	$41,799	$41,799	$41,799

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT				
	FUTURE FUNDING PERIODS (YEARS)			
(a) Grant Program	(b) First	(c)Second	(d) Third	(e) Fourth
16. Bay-Delta Program	$ $159,511	$ $165,892	$	$
17.				
18.				
19.				
20. TOTALS (sum of lines 16 - 19)	$159,511	$165,892	$0	$0

SECTION F - OTHER BUDGET INFORMATION		
21. Direct Charges: $0	22. Indirect Charges	$335,100 Base (Modified Total Direct Cost) $157,497 Total Indirect Expense (47% MTDC)
23. Remarks		

Standard Form 424A (Rev. 4-92) Page2

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